




Part I

The Zen of Getting Started



Welcome to Part I of *Programming The Nintendo Game Boy Advance: The Unofficial Guide*. Part I includes four chapters that introduce you to the Game Boy Advance. Starting with an overview of the video game industry (and a history of Nintendo that leads up to the Game Boy), this part goes into detail about the internal workings of the Game Boy Advance, and then provides a tour of the integrated development environment, Visual HAM, the HAM development toolkit, and Visual Boy Advance emulator. Finally, this part shows how to write, compile, and run several Game Boy programs, using the emulator, and also on an actual Game Boy.

Chapter 1 — Welcome To The Console World

Chapter 2 — Game Boy Architecture In A Nutshell


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Chapter 1

Welcome To The Console World



Welcome to the new horizon of console programming. This may be the first book of its kind to cover the intricacies and complexity of programming a video game console. The Game Boy Advance is a proprietary handheld video game system and is one of the many wonderful and enjoyable consoles developed by Nintendo. The Game Boy Advance is a successor of the original Nintendo Entertainment System (NES) and Super NES and has reestablished some of the greatest game franchises of all time (which were lost when Nintendo delved into the 3D realm with the Nintendo 64 and GameCube).

This chapter is a historical overview of the industry, the company, and the machine. While not directly helpful in a programming sense, this material is nonetheless necessary in order to properly understand this little machine. By understanding the Game Boy's target audience, history, strengths, weaknesses, features, and flaws, one is better able to maximize the potential of the games that will be written for this handheld console. This chapter also delves into the console industry, describing where the Game Boy fits in with other consoles, and basically sets the pace for the rest of the book.

Here are the highlights of this chapter:

- A general introduction to video games
- A brief history of Nintendo
- A note about the importance of having goals

Portable Video Games!

Take a look at Figure 1.1 for a moment. This is a very small video game system called the Nintendo Game Boy Advance. As you are reading this book, I assume you know this already. But take a second look. The Game Boy Advance (also called GBA) is so small, so unassuming! What is all the fuss about regarding this little machine? Well, for starters, it's a self-contained video game console in a handheld case. What is packed away inside that case . . . now *that* is what has everyone so excited. The GBA is what many have called the *perfect* console. The notable exception to this endorsement is a dim color screen that is difficult to see. However, there is a solution to that problem, as I will discuss in the next chapter. A *truly* perfect console is a GBA with a backlit screen (and I'm not talking about the SP model). But I don't want to give away all the details right off the bat




Figure 1.1
The Game Boy Advance, circa 2001.

Getting into the Nintendo Thing

Possibly the greatest and most well-known video game character in history is Mario, who first appeared in the arcade game Donkey Kong in 1981. Donkey Kong was the first game designed by Shigeru Miyamoto, and it was hugely popular in the United States. Although originally named Jumpman, and originally a carpenter, the likeness of Mario was first established in this seminal video game character. Jumpman the carpenter was transformed into Mario later in Donkey Kong Jr. and then gained a new profession as a plumber in Mario Bros., oddly enough.

The 2D side-scrolling classic game that put the NES at the top of the industry, *Super Mario Bros.*, was revived for Game Boy Color in an accurate conversion called *Super Mario Bros. Deluxe*. In that respect, as the first Game Boy with a color screen, the Game Boy Color is a portable version of the NES. Many great old favorites were converted and updated from



NES, such as *Super Mario Bros.*, *R-Type*, *The Legend of Zelda (Link's Awakening, Oracle of Ages, and Oracle of Seasons)*, *Castlevania*, and literally hundreds more.

The Game Boy Advance is a whole new banana, equivalent to a souped-up Super NES, with a landscape-oriented 4:3 ratio LCD screen, a fast CPU, and plenty of memory. (I cover the specifics of the hardware in the next chapter.) The Game Boy Advance continues the tradition set forth by the Game Boy Color and expands upon some great game franchises, as well as offering new remakes of classic games.

Console Contemplation

If you are a PC guru, you will have to put your prejudices on the shelf when working with consoles, because hardware is not directly comparable. For one thing, computers are multipurpose machines. Yes, a significant number are dedicated to gaming, but consoles are specifically built to do one thing: play video games. As such, consoles are extremely efficient at displaying graphics. The GameCube, for example, is equipped with 48 MB of RAM. But that is not how console programmers think. In the console realm, everything is a bit. Bytes are the rule of the PC realm because originally everything on the PC revolved around characters: data entry, text screens, Teletype terminals, dot-matrix printers, and so on.

A character on a PC is based on the ASCII code, wherein each character is 1 byte. A console, in contrast, doesn't even have a text mode. Consoles work exclusively with bits, and as you know, there are 8 bits in 1 byte. So, when talking about consoles such as the GameCube, you should properly speak the terminology: It has 384 megabits (or Mbits) of memory. This will make so much more sense when we go over the Game Boy Advance hardware in detail in the next chapter.

Definition of a Video Game

Okay, this might go without saying, but it is important to get the terminology down before getting too deep into programming a console, especially if your background is in PCs. So what is a video game? *The American Heritage Dictionary* defines a video game as "an electronic or computerized game played by manipulating images on a video display or television screen." In contrast, a computer game is defined as "a game played against a computer."

See the distinction? Video games and computer games are not one and the same, just as PCs are not in the same category as consoles. Since we humans find comfort with categorizations, let's get one thing clear up front: Max Payne would get owned by Sam Fisher. Categorize *that* in your list of facts, and bring on the bullet time! In fact, rumor says Payne came over to the consoles to get some respect, while Fisher went to the PC to do some more damage.

A blockbuster video game is more than the sum of its bits. There is a mysterious aura around a cartridge that brings so much gaming goodness. Word to that game! A master like Shigeru Miyamoto or Yu Suzuki comes along about once every decade and presents a genre-busting ubergame that fosters about a hundred copycat games and keeps the gaming industry rocking until the next genius comes along—or until one of the masters produces a sequel or something new.

A Brief History of Nintendo

Nintendo did not always make video games. In fact, the name *Nintendo* was established in 1951, and the company was actually founded way back in 1889. That company was called Marufuku Company, founded in Japan by Fusajiro Yamauchi. The important factor to consider is that Marufuku was involved in games, even if just card games. The card games that Marufuku manufactured were called Hanafuda playing cards, and in 1902 Yamauchi expanded into other types of playing cards.

In 1951 Marufuku Company was renamed Nintendo Playing Card Company. The word *Nintendo* consists of three kanji characters that translate to "leave luck to heaven." Nintendo got into the toy manufacturing business in the 1970s, building toys such as light guns. Nintendo's first video game machine was actually a license to sell the Magnavox Odyssey in Japan in 1975. Nintendo's experience with the Odyssey helped the company to develop its own video games. In 1977, in a joint venture with Mitsubishi, Nintendo created the TV-Game 6 and TV-Game 15 systems, which were Pong copycats.

In 1978 Nintendo built its first arcade game, a small table-sized cabinet called *Computer Othello*, which featured 10 buttons. This game was not a serious competitor for *Space Invaders*, which also came out in 1978, but did help to launch Nintendo's arcade game division. The year 1980 saw the introduction of *Radar Scope*, which sold poorly (leaving Nintendo with 2,000 unsold cabinets), but an interesting lead-in story. Keep in mind that, at

this point, the Atari 2600 dominated the home console market, while Nintendo was busy gaining experience in the arcade business.

Shigeru Miyamoto

The president of Nintendo, Hiroshi Yamauchi, decided to replace *Radar Scope* boards with a new game rather than recall the unsold cabinets, but that new game would have to be able to run on the *Radar Scope* boards. Enter Shigeru Miyamoto. Yamauchi hired Miyamoto as a staff artist, as a personal favor for a friend, Miyamoto's father. Yamauchi tasked Miyamoto with the job of writing a game for the *Radar Scope* boards, so a simple upgrade could be performed to the existing cabinets.

Miyamoto had no idea how to write a game, so he worked with the video game designers to translate his designs into a game. His design called for a small animated carpenter that could run, jump, climb ladders, and defeat a gorilla named Donkey Kong in order to save a blonde girl (who was held captive by Donkey Kong at the top of the screen). *Donkey Kong* firmly established Nintendo as a force to be reckoned with in the arcade business, and the company went on to produce many more arcade games (as shown earlier).

Miyamoto was finally credited formally by Nintendo in 1996 (at the launch of Super Mario 64) for his contribution to the company and the game industry.

Home Consoles

In 1983 Nintendo introduced the 8-bit NES in Japan, with launch titles *Donkey Kong*, *Donkey Kong Jr.*, and *Popeye*. Timing was very important, because the United States had just gone through a video game crash, largely due to the failure of Atari and other consoles (due in large part to poor management decisions that miscalculated demand). As a result of poor market conditions, Nintendo didn't release an American version of the Famicom until 1985. When Nintendo's first console did finally reach U.S. shores, Nintendo had 90 percent of the Japanese market. The NES quickly dominated the U.S. market as well. (In fact, Nintendo was so worried about U.S. sales that it marketed the Famicom as an educational computer system, complete with a talking robot.)

During the lifetime of the NES, hundreds upon hundreds of games were produced for this console. This system was released in Japan as the Family Computer, or Famicom, and featured the 8-bit 6502 microprocessor, with a clock speed of only 1,790 kilohertz (1.79

MHz!). Many popular American computers used this chip: Apple, Atari, and Commodore, among others. This is the console that established Nintendo as the firm leader in the console business, and the company poured its resources into this division, dropping out of the arcade business altogether.

The year 1989 saw the introduction of the first Game Boy, which would become the beginning of Nintendo's domination of the handheld market. The Game Boy was designed by Gunpei Yokoi, who had designed the Game & Watch handheld games for Nintendo earlier in the 1980s.

Gunpei Yokoi was posthumously honored with a lifetime achievement award at the Game Developer's Choice Awards, presented by the International Game Developer's Association in San Jose on March 6, 2003, for his work on the Game Boy and for co-creating many blockbuster franchises such as Donkey Kong, Mario, and Metroid. With more than 140 million units sold worldwide, his Game Boy was the most successful video game system ever made. The award was accepted by the Yokoi family on his behalf. Rest in peace, Yokoi-san.

Console manufacturers measure the system, data, and storage capacity in bits, rather than bytes. To convert bits to the more familiar bytes format, simply divide a number by 8. For example, the Game Boy is equipped with 64 kilobits (Kbits) of memory, which equates to 8 kilobytes (KB). I use these terms somewhat interchangeably throughout the book, denoted by Kbit or KB.

The 16-Bit Era

In 1991 the 16-bit Super NES was released, and with it the fantastic *Super Mario World*. This time, however, Nintendo faced a strong rival in Sega, with its equally powerful 16-bit Genesis console and an equally popular *Sonic the Hedgehog*. In 1991 Sega released the Game Gear handheld video game system. In every respect, the Game Gear blew the Game Boy out of the water: graphics, sound, color, backlight, and processing power. But part of the problem with the Game Gear was battery life, something that made Game Boy more appealing. (About the same time, Atari released a color handheld system as well, called the Lynx.) And in usual Nintendo fashion, Game Boy showed that technology doesn't matter, games do. A simple and unassuming game called Tetris, bundled with the early Game Boy, helped Nintendo's handheld to quickly dominate the market.

Success and Failure

Facing a serious competitor, Nintendo was at a crossroads in the early 1990s. The 16-bit consoles had a long potential life span, as had the 8-bit consoles. But anything could happen in the video game market during the estimated five-year lifetime of the Super NES. Nintendo really had no plan for the next system yet. The next logical step would be a

migration to 32 bits. While some sort of 32-bit Nintendo console was expected from everyone, Nintendo made a very strange decision for its next system. Virtual Boy is an example of what happens when marketing people—instead of game designers and developers—make the decisions in a video game company. This ugly mistake was driven by the popularity of virtual reality in the early 1990s, and it was a complete failure (as right it should have been).

A Detailed Comparison

Table 1.1 summarizes the history of the major video game consoles over the past 20 years.

Year	Manufacturer	Console	Bus
1985	Nintendo	NES	8-bit
1989	Atari	Lynx	8-bit
1989	Nintendo	Game Boy	8-bit
1990	Sega	Genesis	16-bit
1990	NEC	TurboGrafix 16	16-bit
1991	Nintendo	SNES	16-bit
1991	Sega	Game Gear	8-bit
1993	Atari	Jaguar	64-bit
1993	Sega	32X	32-bit
1994	Sega	Saturn	32-bit
1994	Nintendo	Virtual Boy	32-bit
1995	Sony	PlayStation	32-bit
1996	Nintendo	Game Boy Pocket	8-bit
1996	Nintendo	Nintendo 64	64-bit
1998	Nintendo	Game Boy Color	16-bit
1999	Sega	Dreamcast	128-bit
2000	Sony	PlayStation 2	128-bit
2001	Nintendo	Game Boy Advance	32-bit
2001	Nintendo	GameCube	128-bit
2001	Microsoft	Xbox	128-bit

Now, unless one has a strong bias for one console or another, it is interesting to note that Nintendo is the only company to have released 8-bit, 16-bit, and 32-bit consoles (Game Boys) successfully in recent years. I also find it interesting that Nintendo was the only manufacturer to produce both a 64-bit and a 128-bit console. It is evident from this list that Nintendo dominates the video game industry, even to this day. Despite the sales, growth, and popularity of other consoles, it must be noted that Nintendo's business practices are efficient and effective.

What Happened to the Atari Jaguar?

The story of the Atari Jaguar is one of frustration. The Jaguar, back in 1993, was similar to a Nintendo 64 and a PlayStation (both of which arrived on the scene a few years later) and was manufactured by IBM (the same company that designed and built the GameCube's central processor). The Atari Jaguar design team must have had fantastic dreams for this console, and I share that dream. With a two to three year lead on the competition, why didn't the Jaguar totally cream the competition?

Most certainly, it was a lack of solid third-party development commitments that spelled the downfall of the Jaguar, along with perhaps poor marketing, because Atari had such a huge lead on the competition, the Jaguar should have been more successful. So what happened?. Despite solid titles like *Wolfenstein 3D* and *Doom*, with an endorsement from id Software, this is a real-world example that demonstrates the most important factor in console development: Technology doesn't sell, games do. There were some notable games for the Jaguar, such as *Alien vs. Predator*, *Golden Axe*, and numerous arcade ports, but the established customer base of the SNES and Genesis held the Jaguar back.

The Importance of Goals

Do you have what it takes to follow in the footsteps of master game developers, to rock the establishment and invent new genres that challenge our comfortable list of game categories and give marketing people a headache? While you are learning the ropes, write as many copycat games as you can manage. If you are up to the task of reproducing *Super Mario Bros.* or *The Legend of Zelda: A Link to the Past*, do it. You will only master the genres and break them up by remaking the original genre-establishing games and coming up with ideas of your own. By the time you are done with this book, you will have the knowledge and know-how to reproduce most of the Game Boy games out there.

Use Your Imagination

Use your fresh insight and your imagination. Don't be concerned with telling others about your ideas, building ridiculous Web sites about your nonexistent game, and releasing the grossly mislabeled "betas" after finishing the title screen of a game. If you know your game rocks, then a great number of gamers will feel the same way after playing your game. But finish your game . . . completely . . . before even mentioning it! Do that, and you will gain unequalled respect by your peers, and perhaps even a few game companies. You will be taken seriously. (Many, many of the greatest in the business got started writing games for fun, not for profit.) You will surprise everyone. There's nothing, and I mean *nothing*, as cool as a brand new game released without any warning! Especially if that game is a lot of fun.

Build a Franchise

The first game released by id Software was *Commander Keen*, which was a PC shareware game. Ironically, *Commander Keen* has been ported to the Game Boy Advance! If you haven't played the game, I highly recommend it, because this is a great old-school platformer, created by John Carmack, John Romero, and Adrian Carmack. *Wolfenstein 3D* and *Doom* have also been ported to GBA, and John Romero is now producing portable games exclusively under the MonkeyStone label; his latest GBA game, *Hyperspace Delivery Boy*, is a top-view adventure game with a sci-fi theme.

Do you see any correlation between these PC masters and the console masters? Compare the works of John Romero with the works of Shigeru Miyamoto. Not every game is a smash hit (and there are even some real stinkers). But the theme of "franchise" is evident in games created by these masters of the game.

Genre- and Character-Based Franchises

Can you think of a theme that is brand new, has never been done before, that you can call your own? Create your own genre and build upon your brand-new characters, just as Miyamoto did with *Donkey Kong*, *Donkey Kong Jr.*, and *Mario Bros.*, and as he perfected with *Super Mario Bros.* Do you see how it took four games featuring the seminal "Mario" before Miyamoto had the characters, backgrounds, and foes he really wanted? (Alternately, you might build a franchise genre, as id Software did, starting with *Wolfenstein 3D* and on through several games to *Doom III* and beyond.)

You will see that even the latest *Super Mario Sunshine* features baddies from those old games, developed decades ago. Build your own franchise—that is the key to success in the video game industry. Think about all the great classics, and you will see a lineage, a dynasty, of unique characters. Think about *Sonic the Hedgehog*, *Castlevania*, *Mario*, *Zelda*, *Metroid*, *Bombberman*, *Contra*, and *R-Type*. The history is sometimes as much fun as the games themselves. If *Super Mario Sunshine* had been named something like "Mechanic Sunshine" and featured a wrench-toting little guy going around fixing the environment, do you think it would have been the same game? No, most of the sales for that game came from the title alone, because Mario games have a history of being fantastic. If you like Coke, and something new like Vanilla Coke comes out, you are probably going to like it regardless, because the familiarity of name and similarity of good taste appeal to memories of the fun you have had in the past with that product. This principle doesn't apply to every situation, of course. Some game franchises are becoming a scourge of sequel overkill. It's not great quantity that gamers are seeking, but gameplay.

I believe that if *Super Mario 64* had failed in gameplay, fans of the series would have been skeptical of *Super Mario Sunshine*, due to the 3D factor. *Super Mario 64* was a difficult game to master, and the camera was difficult and unwieldy (at least at first), but the gameplay fascinated a generation of gamers and formally ushered in the beginning of full 3D games (not to be confused with first-person shooters).

Strike a Balance: Level Count vs. Difficulty

How many genres has Miyamoto invented altogether? Quite a few, I would guess. *Super Mario 64* was a gamble, but the familiar gameplay of the original NES and Super NES games was translated into the third dimension perfectly. The character did feel like Mario, and this timeless classic is now considered by many as the greatest game of the 20th century. How could a great series like this have come from a weird (but fun) arcade game called *Donkey Kong*? Diversity of characters (such as plumbers and dinosaurs), creative themes (such as gathering coins), and familiar creatures (such as turtles) used as baddies.

And don't forget about the sound effects and music, which are just as endearing to the Mario dynasty as the graphics. My theory is that Mario games involve a *lot* of levels and baddies to beat, rather than a few difficult ones, and that is what makes them so much fun. Who wants to repeat the same level over and over again, without reward? (That gameplay decision alone turns me off to many, many games . . .). Difficulty level in a game can be balanced with the number of levels in the game. Increasing one usually involves decreasing the other, like a teeter-totter.

Surprise the Critics

What will you invent that people will be playing for decades to come? Grasp the concepts in this book as much as the programming aspects, and start inventing. Do the games first, and the career will come (if that is what you are seeking). This really flies in the face of career game developers who really have no love for games. Those people should get out of the way for real talent, because they are responsible for the many mediocre games we must wade through to find the gems.

Do you recall the feeling of discovering a new game that you have never played before, and how it blows you away because it is so much fun? After you finish the game, you desperately look for sequels or similar games or downloadable updates (which are becoming more common for consoles now with online capabilities). That is the market for copycat games. But the point is to try to grasp what makes those games so much fun and then emulate those concepts in your own games. Don't copy them pixel by pixel!

What I mean is, essentially, to learn about what works and what fails and then emulate the themes that work, combined with the machinations of your own imagination. If you love mindless shooting games like *Smash TV*, then do your own with variations on the theme, and make it a totally different game. Do this while learning the tricks of the trade, until such time that you are able to take hold of a truly unique and fun idea of your own. Here is a breakdown:

1. Inspiration.

Inspired by a great game, you dream of making a similar game.

2. Emulation.

Your first attempts are copycat games, as you develop your skills.

3. Imagination.

Finally, you are able to incorporate new ideas into your own creations.

I will cover more game design aspects in a limited fashion throughout the rest of the book as this subject relates to each chapter.

Summary

This chapter presented an overview of the video game market, with a short history lesson about Nintendo and the developments that led to the Game Boy Advance, including an overview of the major consoles that have been released in the past two decades. This

chapter also covered some aspects of game design that might help aspiring game developers to focus their talent in productive ways. Finally, this chapter set the pace for the rest of the book, establishing the types of subjects and themes that will be focused on in following chapters.

Chapter Quiz

The following quiz will help to further reinforce the information covered in this chapter. The quiz consists of 10 multiple-choice questions with up to four possible answers. The answers may be found in Appendix D, "Answers To The Chapter Quizzes."

1. What is the name of the company that created the Game Boy Advance?
 - A. Sega
 - B. Nintendo
 - C. Atari
 - D. Sony
2. Which of the following classic NES games have been upgraded for the Game Boy Advance?
 - A. *Virtua Fighter*
 - B. *Sonic The Hedgehog*
 - C. *Super Mario Bros.*
 - D. *Golgo 13*
3. How many megabytes are there in 384 megabits?
 - A. 48
 - B. 16
 - C. 32
 - D. 64
4. Who designed the game *Donkey Kong*?
 - A. Hiroshi Yamauchi
 - B. Gunpei Yokoi
 - C. Yu Suzuki
 - D. Shigeru Miyamoto
5. Who, in 1889, founded the company that would eventually become known as Nintendo?
 - A. Shigeru Miyamoto
 - B. Fusajiro Yamauchi
 - C. Gunpei Yokoi
 - D. Hiroshi Yamauchi

6. What does the word "Nin-ten-do", derived from Kanji characters, stand for?
 - A. "Leave luck to heaven"
 - B. "The video game company"
 - C. "We sell card games"
 - D. "Have yen, play game"

7. What was the Nintendo Entertainment System called in Japan?
 - A. NES
 - B. Mario Machine
 - C. Family Computer
 - D. Super Famicom

8. What was Nintendo's first arcade video game called?
 - A. Donkey Kong
 - B. Space Invaders
 - C. Mario Bros.
 - D. Computer Othello

9. Who invented the Game Boy?
 - A. Gunpei Yokoi
 - B. Shigeru Miyamoto
 - C. Yu Suzuki
 - D. John Romero

10. What is the system bus bit depth of the Game Boy Advance?
 - A. 16-bit
 - B. 32-bit
 - C. 64-bit
 - D. 128-bit